

## Solar Energy: Energy Future of India

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### Abstract:

Energy plays an important role in the economic growth and is very crucial for supporting a contemporary economy and society. India's economy is growing at a fast rate and so is the demand for energy. More than 60 per cent of energy is derived from burning of fossil fuels. These conventional energy resources are not only limited but their use is deteriorating air quality and has become a precursor for the climate change. There is an urgent need to shift on clean energy to sustain economy without degrading the environment. Clean energy, specifically solar energy, is the answer for growing demands of energy as this is abundant, pollution free and unlimited. This paper focuses on the wide potential of India in terms of solar energy, advantages of this clean energy along with the challenges. This paper aims to review the development of India's on-grid solar electricity. This paper also focuses on government policies on solar energy sector to reduce its carbon intensity.

**Keywords:** Renewable energy, solar energy, clean energy, government policies.

### Introduction:

Energy is the principal agent of a country's economy. The demand for energy is increasing exponentially with the rapid increase in population and steep economic growth. India was ranked as the third in global energy consumption and as fifth highest in global electricity consumption in 2012. India accounts for more than 60 per cent of energy from burning of fossil fuels.

Continuing the use of fossil fuels is set to face multiple challenges like depletion of fossil fuel reserves, global warming and other environmental concerns and significant fuel price rise. Therefore, there is an urgent need to shift on clean energy like solar energy for the sustainable development. In 2014, out of the total installed capacity of 255GW, conventional sources shared about 70%, out of which coal alone accounted for 84%.

Hydroelectric ranked second and renewable energy sources ranked third. (Table 1)

Fuel source	Installed capacity(MW)	Share(%)
coal	153,571	60
Gas	22,971	9
Oil	1,200	<1
Hydro	40,799	16
Nuclear	4,789	2
Other Renewable	31,692	12
<b>TOTAL</b>	<b>155,013</b>	<b>100</b>

Source: Central Electricity Authority, Ministry of Power, Government of India; 2014

Table 1: The share of different sources in India's on-grid installed capacity in 2014.

In developing countries like India, the use of renewable energy in electricity sector has become significantly higher in recent years (table 2).

Renewable energy sources are being realised as a sustainable way to address the gap between growing demand and supply, energy security, energy equity with safe and appropriate access and most importantly, the global commitment to emissions reductions.

Renewable	1992	2002	2007	2012	2014	2015
Wind Power	38	1667	7094	17352	20298	25188
Small Hydro	79	1438	1975	3395	3774	4188
Solar Power	0.6	1	2	941	2208	5248
Biomass Power	-	390	1140	3135	3797	4761
Waste To Energy	-	-	43	89	99	127
<b>Total</b>	<b>118</b>	<b>3496</b>	<b>10253</b>	<b>24912</b>	<b>30176</b>	<b>39511</b>

Source: MNRE(2016)

Table 2: The growth of different on-grid renewable options in MW.

Across the country, eight States, including Tamil Nadu, Andhra Pradesh, Karnataka, Gujarat, Maharashtra, Rajasthan, Himachal Pradesh, and Jammu & Kashmir, account for 80–90% of existing total renewable capacity in the country.

Among them, Rajasthan and Gujarat are leading with highest installed capacity for on-grid solar(PV), and Tamil Nadu and Gujarat are leading for wind power.

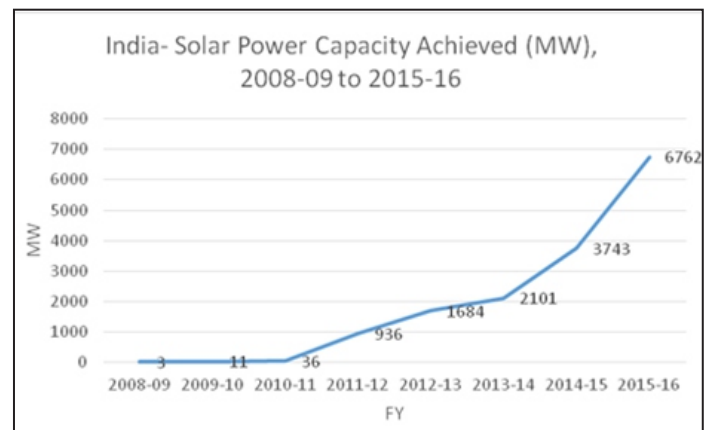
### Solar energy: Indian scenario

India is a tropical country, receives abundance of solar radiation thus India has a wide potential for solar energy. India is already a leading in wind power generation.

With about 300 clear, sunny days in a year, India’s theoretical solar power reception ,on only its land area ,is about 5000 pet watt-hours per year(PWh/yr)(i.e. 5000 trillion kWh/yr).

The daily average solar energy incident over India varies from 4 to 7 kWh/m<sup>2</sup> with about 1500-2000 sunshine hours per year, which is far more than current total energy consumption.

Since 2008, India has significantly rising in terms of solar power capacity achievement. India has seen an exponential growth in solar energy sector from 2010-11. It started off with 3 MW in 2008-09 and has touched 8000 MW (8GW) by July end, 2016 (fig2).



Source: SECI (2014) and MNRE (2016)

Figure 2: India- Solar Power Capacity Achieved (MW), 2008-09 to 2015-16

### Solar energy: government’s policies

#### Jawaharlal Nehru National Solar Mission

The Jawaharlal Nehru National Solar Mission, also known as National Solar Mission, is one of the eight keys of National Mission’s which comprise India’s National Action Plan on Climate Change(NAPCC). NAPCC was launched on 30th June 2008 which identified development of solar energy technologies in the country as a National Mission. National solar mission is a landmark initiative by the government of India.

The program was inaugurated by then Prime Minister of India, Dr. Manmohan Singh on 11th January, 2010 with a target of 20GW by 2022 which was later increased to 100 GW in 2015 by NDA government, which is divided as 60GW of land mounted grid connected solar power and 40GW of rooftop grid interactive solar power. This has been further divided into the following yearly targets from FY 2015-16 to FY 2021-22.

Category	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	Total
Roof Top Solar	200	4800	5,000	6,000	7,000	8,000	9,000	40,000
Ground Mounted Solar	1,800	7,200	10,000	10,000	10,000	9,500	8,500	57,000
<b>Total</b>	<b>2,000</b>	<b>12,000</b>	<b>15,000</b>	<b>16,000</b>	<b>17,000</b>	<b>17,500</b>	<b>17,500</b>	<b>97,000</b>

Source: Ministry of New and Renewable Energy (MNRE), (2015)

Table 1: Grid Connected Targets (year-wise in MW) for Solar Power Installations

So far by July end, 2016 - India has achieved 8 percent of the total target capacity of 100 GW by 2022. It is very exciting and challenging way ahead for India for scaling up solar power in an accelerated fashion.

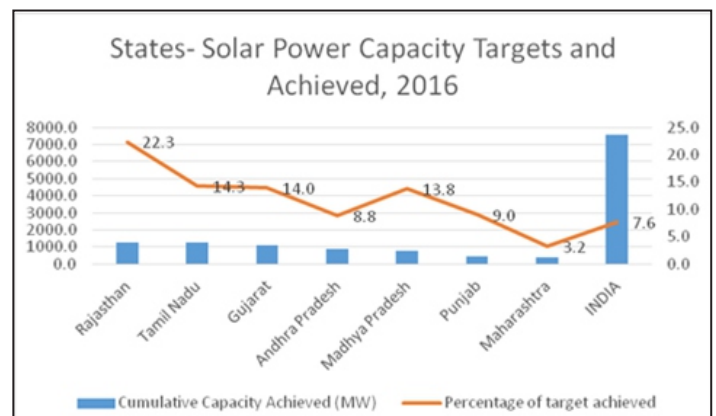
Also, The Prime Minister of India Shri Narendra Modi, and the President of France Mr François Hollande, has jointly laid the foundation stone of the International Solar Alliance (ISA) Headquarters and inaugurated the interim Secretariat of the ISA in National Institute of Solar Energy (NISE), Gwalpahari, Gurgaon on 25 January 2016. The Government has dedicated 5 acre land in NISE campus for the ISA Headquarters and also has contributed Rs 175 crore for ISA corpus fund and also for meeting expenditure for initial five years.

### Solar energy: Indian states

Gujarat has been a pioneer under the former Chief Minister, Narendra Modi (Now the PM) that was first to come up with a solar power policy. It was also the first to come up with an innovation of solar panels atop canals- 1 MW in Mehsana and 10 MW in Vadodra. In the recent years, several Indian States have been active in developing solar power policies. Sixteen states have notified their solar power policies as per MNRE. Out of all, only Jharkhand and Odisha are the eastern states to have notified solar power policies. Others include Andhra Pradesh, Chhattisgarh, Haryana, Gujarat, HP, J&K, Karnataka, Kerala, MP, Rajasthan, TN, Telangana, Uttarakhand and UP.

Solar Thermal technology based power plant of 140MW has been installed at Mathania in Rajasthan. The project configuration of 140MW integrated solar combined cycle power plant which involves a 35MW solar power generating system and also a 105MW conventional power component are involved in this project.

During 2015-16, five states/UTs opened their solar power accounts, which are, moved from zero capacity to some installed capacity. Bihar installed 5.1 MW, Daman & Diu 4 MW, J&K 1 MW, HP added 0.2 MW and Mizoram added 0.1 MW. Given lack of grid lines in far eastern and north eastern regions of the country, there is much scope for solar power in these areas. There is a spatial differential observed in solar energy installations. The eastern and north eastern states lag behind quite a bit with less than 2 percent of all India commissioned capacity. The southern states of Andhra Pradesh, Karnataka, Kerala, TN and Telangana account for about 34 percent. The western states of Rajasthan, Gujarat, MP and Maharashtra account for more than 52 percent of total commissioned capacity (Figure 3).



Source: MNRE

Figure 3: Indian States- Solar Power Capacity Targets and Achieved, 2016

### Solar energy: challenges

There are various challenges to be faced by solar sector like lowering the production cost, increasing R&D activities, consumer consciousness, improvement of standards and more financial support. It is very essential to overcome these challenges for rapid growth and mass acceptance of this energy sector. Some of the immediate actions to enable growth include efficient implementation of renewable energy certificates, usage of carbon

trading as a source of income, improvement of financing facility, encouragement in private investment, quick implementation of net metering scheme, policy mixing, rapid implementation of grid-powered energy in regions of Rajasthan and Gujarat, development of off-grid usage in various applications such as cellular towers and encouraging localized mini grids in areas that lack connectivity today. Research and development activities need to be strengthened in private sectors and educational institutions. Millions of productive jobs will be created from the need to develop infra-structure, which is required for the new industries and results from the establishment of massive solar projects. Publicizing job creation, in addition to environmental and energy access compensation, will strengthen the economic case for clean energy policies and build public support for these initiatives. The combined effort of government, private sectors, and civil society will bring a revolutionary change in building solar power in India. If these initiatives work as planned, materializing the dream of converting India into a world leader in solar energy market would not be far away.

### **Conclusion:**

With a growing population and a rapid shift towards energy intensive lifestyles, the demand for energy will keep increasing. Today, about 60 percent of India's power requirements are met by burning coal, which is damaging the environment. So, India needs to reduce its dependence on fossil fuels for a better future. Around the world, there is a greater acknowledgement and shift towards the use of renewable forms of energy. Solar energy is one form of energy that can be an alternative source of power supply. Solar thermal technology is commonly used today for electricity production, which is one of the best options for meeting the energy demand of developed and developing countries. In future India can meet the challenge of electricity generation according to the Indian population requirement with the help of concentrating solar thermal power technology. Also, solar energy provides a golden opportunity for India to move toward a 100 per cent clean energy future while reducing poverty, ensuring energy security and combating the climate change. Solar energy has the potential to propel India forward as a "Solar Super Power."

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